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A method for determining concentration; a dialyser

Claims

1. A method for determining the concentration of an ion, atom or molecule bound in a complex,

characterised in that

the complexing of the ion, atom or molecule is prevented at least during the determination of the concentration by the addition or withdrawal of a substance.
2. A method in accordance with claim 1, wherein the added substance is an acid and the complexing is prevented by a pH change.
3. A method in accordance with claim 1, wherein the complexing is prevented in that the addition of the complexing agent is interrupted or that the complexing agent enters into a complex with another added substance and thereby releases the ion, atom or molecule whose concentration is to be determined.

4. A method in accordance with any of claims 1 to 3, wherein it is a question of a method for determining the ion concentration of blood of a patient in haemo-dialysis and/or haemo-filtration anti-coagulated with citrate, with the ion concentration of the blood being determined on the basis of the determination of the ion concentration in the dialysate and with the complexing of the relevant ion with citrate being prevented before the determination of the ion concentration in the dialysate for the purpose of determining the concentration.
5. A method in accordance with claim 4, wherein the complexing is prevented in that the citrate addition into the blood circulation is temporarily interrupted.
6. A method in accordance with claim 4, wherein the complexing is prevented in that the ion is released from the ion/citrate complex in the dialysate by lowering the pH.
7. A method in accordance with claim 5, wherein the measurement of the ion concentration in the dialysate is carried out after interrupting the citrate addition at the end of a length of time which is composed of a dead time caused by dead volumes and of a period of time required to reach a quasi-stationary state.
8. A method in accordance with claim 5, wherein the measurement of the ion concentration in the dialysate is carried out a multiple of times after interrupting the citrate addition and the measured value is determined after reaching a quasi-stationary state.
9. A method in accordance with claim 5, wherein the measurement of the ion concentration is repeated a multiple of times after interrupting the citrate

addition and the measured value is determined by extrapolation of the ion concentrations obtained in the dialysate.

10. A method in accordance with claim 5, wherein the citrate concentration is interrupted for a pre-determined time interval and the measured value is determined by integration of the area of the response function defined by the ion concentration in the dialysate as a function of time.
11. A method in accordance with claim 6, wherein the pH is set to the range $\text{pH} = 2-3$.
12. A method in accordance with either of claims 6 or 11, wherein the setting of the pH in the dialysate takes place by means of an infusion of acid.
13. A method in accordance with any of claims 4 to 12, wherein the dialysate flow is reduced for the purpose of approximating the ion concentration of the dialysate to the ion concentration of the blood.
14. A method in accordance with any of claims 4 to 13, wherein the determination of the ion concentration of the blood takes place by calculation without reducing the dialysate flow.
15. A method in accordance with any of claims 4 to 14, wherein the detection of the ion concentration in the dialysate takes place by means of an ion-sensitive sensor in the dialysate flowing away from the dialyser.
16. A method in accordance with any of claims 4 to 15, wherein the determined ion concentration of the blood of a patient serves as a controlled variable whose value is influenced by the control variables of citrate addition and/or addition of a substitution medium containing ions.

17. A method in accordance with any of claims 4 to 16, wherein an alarm is triggered when the determined ion concentration in the blood of the patient lies outside a permitted range or differs from a permitted value.
18. A method in accordance with any of claims 4 to 17, wherein the ion concentration in the compartment of the dialyser on the blood side is determined without interrupting the citrate supply and is compared with a permitted threshold value of the ion concentration and the citrate feed is changed in dependence on this comparison.
19. A method in accordance with any of claims 4 to 18, wherein the ions are calcium ions and/or magnesium ions.
20. A dialyser having a haemo-dialyser and/or a haemo-filter and having an extra-corporal blood circulation with which means for the adding of citrate to the blood are connected upstream of the haemo-dialyser and/or of the haemo-filter and means for the adding of a substitution solution containing ions to the blood are connected downstream of the haemo-dialyser and/or of the haemo-filter, and having a dialysate line which has means for the detection of an ion concentration in the dialysate downstream of the haemo-dialyser and/or of the haemo-filter with respect to the direction of flow of the dialysate.
21. A dialyser in accordance with claim 20, wherein the means for the detection of the ion concentration are designed in the form of one or more ion-sensitive sensors.

22. A dialyser in accordance with claim 21, wherein a test device is provided which performs a function check of the sensor(s) in time intervals or on actuation by an operator.
23. A dialyser in accordance with any of claims 20 to 22, wherein means for adding a substance are connected to the dialysis line by which the pH of the dialysate can be changed.
24. A dialyser in accordance with claim 23, wherein the means are disposed such that the addition takes place downstream of the dialyser with respect to the direction of flow.
25. A dialyser in accordance with any of claims 20 to 24, wherein means are provided by which the dialysate flow can be reduced temporarily.
26. A dialyser in accordance with any of claims 20 to 25, wherein a control unit is provided which controls the means for adding citrate to the blood in time intervals or on actuation by the operator such that the addition is temporarily interrupted and which records the concentration value determined by the means for detecting an ion concentration in the dialysate after the start of the interruption of the citrate addition continuously or in time intervals.
27. A dialyser in accordance with claim 26, wherein the control unit is designed such that this determines the measured value of the Ca^{++} ion concentration in accordance with a method in accordance with claims 7 to 10.
28. A dialyser in accordance with any of claims 20 to 27, wherein a regulating unit is provided which is connected to the means for detecting an ion concentration

in the dialysate and to the means for adding citrate and/or to the means for adding a substitution solution containing ions and which initiates an increase or a lowering of the addition amount of citrate and/or of substitution solution containing ions in dependence on the comparison between a nominal value or a nominal value range and the determined actual value of the ion concentration.

29. A dialyser in accordance with claim 28, wherein the regulating unit and/or the means for adding citrate are designed such that the concentration of citrate cannot be lowered below a threshold value.
30. A dialyser in accordance with any of claims 20 to 29, wherein an alarm unit is provided which triggers an alarm on determination of a critical individual measurement of the ion concentration or on determination of a critical trend of individual measurements.